

# Digestive System

Food → basic requirements of all living being.

major components of food

Carbohydr. Fats Proteins

Vitamins  
Minerals

Required in small quantities.

- Food gives
  - Energy
  - Organic materials for
    - Growth of tissues
    - Repair of tissues
- Water → Imp role in
  - metabolic processes
  - prevent dehydration of body

Biomacromolecules in food → cannot be utilised by our body in their original form.

Digestion

This process

They have been broken down & converted into simpler subst. in digestive system.

carried out by digestive enzymes

Mechanical methods

Biochemical methods

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AIR 1747

NCERT THREAD NOTES

Digestive system → Alimentary canal + Associated glands

Alimentary Canal

\* Begins with → anterior opening [MOUTH] → ends posteriorly [ANUS]

leads to

Buccal / oral cavity / cavity

has

No. of teeth

Each tooth → embedded in a socket of jaw bone (THECODYNT)

Muscular tongue



- Majority of mammals (including human being)

Forms  
two sets of teeth during life

Temporary/Milk/Deciduous Teeth

Permanent/Adult Teeth

This type of dentition  
Diphyodont

- Adult human has 32 permanent teeth  
4 types heterodont

(I)	(C)	(PM)	(M)
↓	↓	↓	↓
Incisors	Canine	Premolars	Molars

- Order of arrangement of teeth

In each half of upper & lower jaw.

(I)	(C)	(PM)	(M)
2	1	2	3

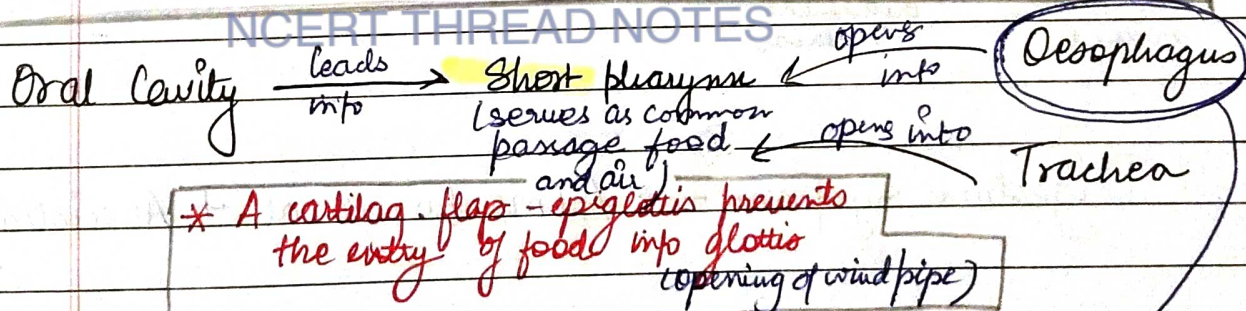
- Enamel → hard chewing surface of teeth  $\xrightarrow{\text{helps in}}$  Mastication of food.

- Tongue → Freely movable muscular organ

Attached to floor of oral cavity by 2 Frenulum.

Upper surface of tongue has small projection "Papillae".

Some of which bear taste buds.



'J' shaped bag - Stomach

leads to

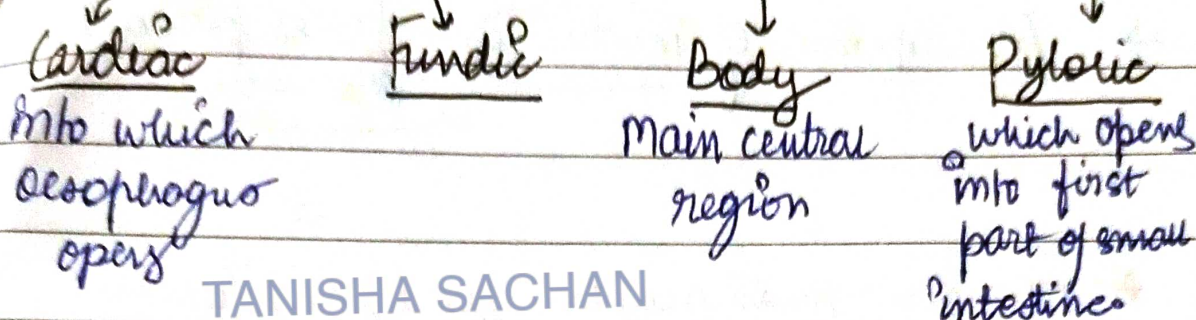
- Thin, long tube
- Extends posteriorly through the neck, thorax & diaphragm

A muscular sphincter "gastro-oesophageal" regulates the opening of oesophagus into stomach.

Located in upper left portion of abdominal cavity.



Stomach has four parts

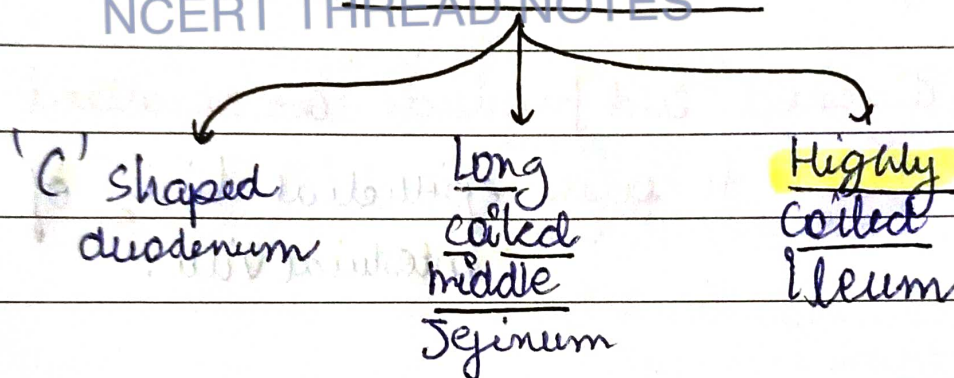


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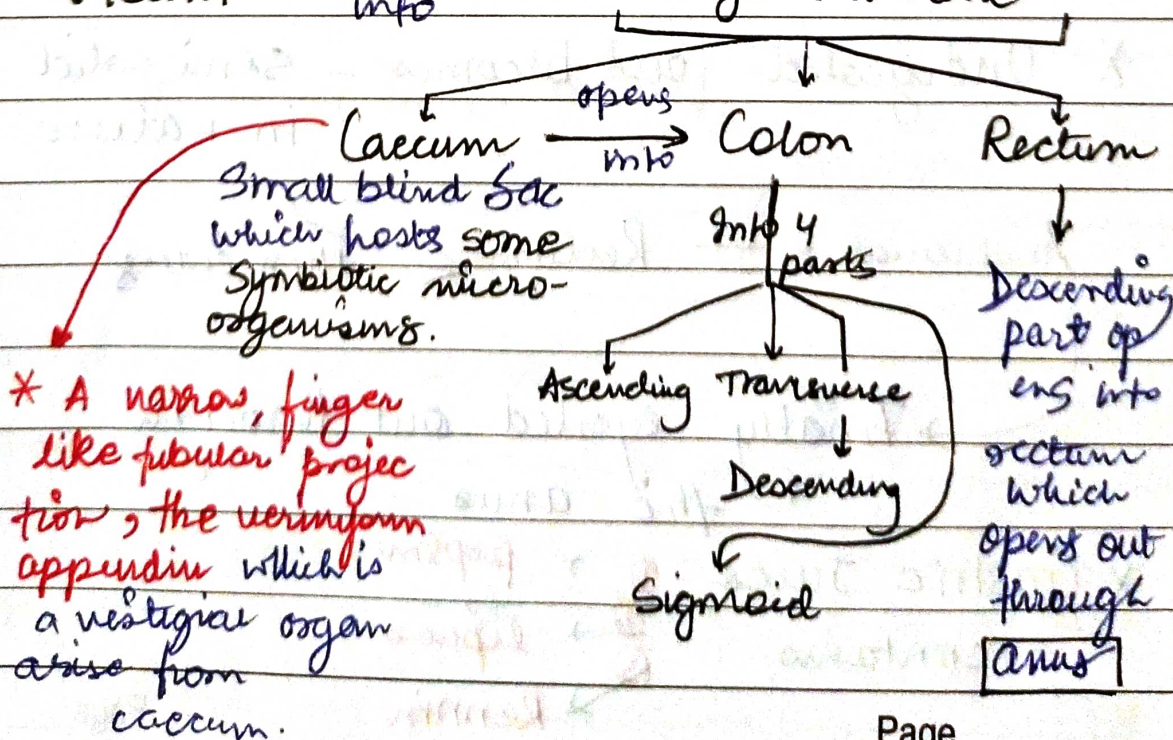
Small Intestine

NCERT THREAD NOTES



Opening of stomach  $\xrightarrow{\text{pyloric sphincter}}$  duodenum

Ileum  $\xrightarrow{\text{opens into}}$  Large Intestine



\* A narrow, finger like tubular projection, the vermiform appendix which is a vestigial organ arise from caecum.



\* In stomach, mainly protein digestion takes place.

\* Absorption of medicine - takes place in stomach

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\* Tongue manipulates food for proper mastication by mixing with saliva.

\* The digested end products are absorbed into body through epithelial lining of intestinal villi.

\* Most of water - absorbed in large intestine

\* Undigested food becomes - semi solid in nature

Anal canal ← Rectum ← then enters

→ Finally egested out through the anus

\* Gastric Juice contains

- ① pepsin
- ② lipase
- ③ Rennin





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# Wall of Alimentary Canal → From "Oesophagus" to "Rectum"

Possess 4 layers

## Serosa

Outermost layer  
of thin mesothelium  
(epithelium of the  
visceral organ)  
with some connective  
tissue fibres.

## Muscularis

Of Smooth Muscles  
arranged into

Inner circular      Outer longitudinal

\* An oblique muscle layer may be present in some region.

## Sub Mucosal layer

Formed of loose connective tissue containing

→ nerve  
→ blood  
→ lymph vessels

In duodenum, glands are also present in sub mucosa.

## Mucosa

Innermost layer lining of the lumen of alimentary canal

Irregular folds in stomach  
↓  
Rugae

Small finger like foldings  
↓  
Villi (in small intestine)

\* Cells lining villi produce numerous projections (microvilli) giving brush border appearance.

These modifications  
↓  
Surface area ↑ enormously

## NCERT THREAD NOTES

\* Villi → supplied with a network of capillaries  
→ large lymph vessel → lacteal

\* Mucosal Epithelium has Goblet cells secretes mucus  
↓  
helps in lubrication

\* Mucosa forms gland in → stomach (gastric glands)  
→ crypts in b/w bases of villi in intestine (Crypts of Lieberkuhn)

\* All the four layers show modifications in different parts on alimentary canal.



# Digestive Glands

Associated with Alimentary canal

- Salivary gland
- Liver (with gall bladder)
- Pancreas.

Saliva produced by  
(3 pairs of salivary glands)  
= 6 salivary glands

neck

Parotids  
(cheek)  
Stensen's duct

Submandillary  
/ Sub-mandibular  
(Lower jaw)  
Wharton

Sub-linguals  
(below the tongue)  
Bartholin

\* These glands situated just outside the buccal cavity secrete salivary juice into the buccal cavity.

Liver

→ largest gland of body

→ weighs 1.2 - 1.5 kg (in adult human)

→ Situated in abdominal cavity → Just below diaphragm & has 2 lobes

Structural & functional unit  
containing hepatic cells in  
the form of cords

Hepatic Lobules

Covered by: Thin connective  
tissue sheath called  
Glisson's Capsule.

Bile

secreted through  
hepatic cells  
passes through  
hepatic ducts

stored  
in

Thin muscular bag  
"Gall bladder"

CYSTIC DUCT

COMMON  
BILE DUCT

PANCREAS

Compound gland  
elongated organ  
situated b/w the limbs  
of 'C' shaped duodenum

hepato-pancreatic  
duct

PANCREATIC  
DUCT

'C' shaped.

sphincter  
of oddi

Exocrine

↓  
alkaline  
pancreatic  
juice

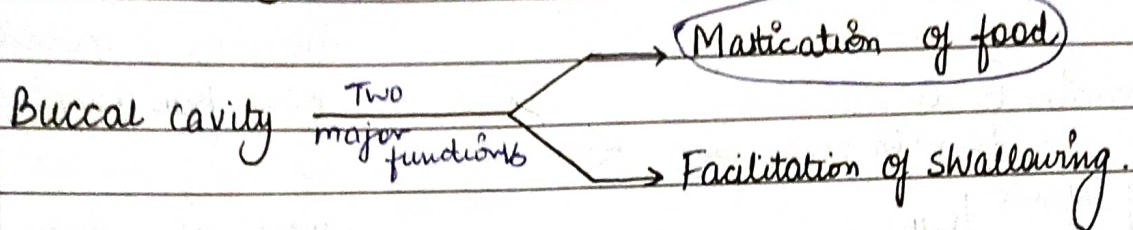
Endocrine

↓  
Hormones  
→ insulin  
→ Glucagon



# DIGESTION OF FOOD

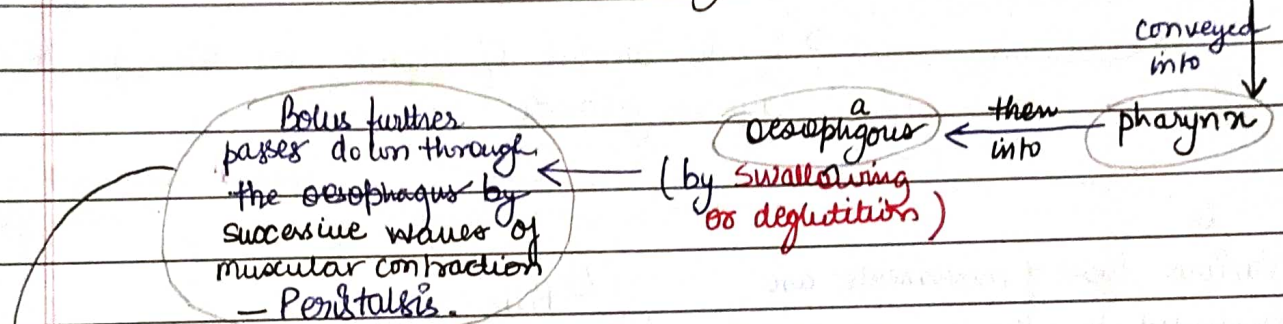
↓  
Accomplished by 3 Mechanical & chemical process. with the help of teeth & tongue and mix with saliva



'Mucus' in saliva helps in

- ① Lubricating
- ② adhering

→ the masticated food particles into Bolus



Gastro-oesophageal sphincter. controls the passage of food into the stomach.

Chemical process of digestion is initiated in the oral cavity.

- Saliva has
- Electrolytes ( $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Cl}^-$ ,  $\text{HCO}_3^-$ )
  - Enzymes - salivary amylase
  - Lysozyme

Hydrolytic action of carbohydrate splitting enzyme

Starch  $\xrightarrow[\text{pH 6-8}]{\text{Salivary amylase}}$  Maltose, dextrin

30% of starch hydrolysed.

Lysozyme - Antibacterial agent (prevent infections)

Mucosa of stom. has gastric glands

have 3 major types

Mucus neck cells (secrete mucus)

Peptic/Chief cells (secrete proenzyme pepsinogen)

Parietal/Oxyntic cells (secrete HCl & Intrinsic factor essential for the absorption of vit. B<sub>12</sub>)

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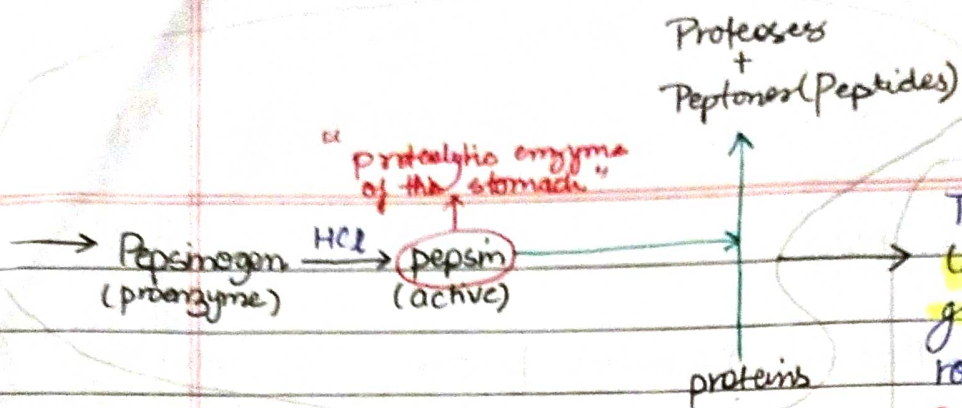
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Food mixes thoroughly with the acidic gastric juice of stomach by churning movements of muscular wall. called Chyme.

Stomach stores food for 4-5 hrs





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The mucus &  $\text{HCO}_3^-$  (bicarbonate) present in gastric juice play a imp role in lubrication & Protection of mucosal epithelium from excoriation by

the highly conc. HCl.

• HCl provide - acidic pH optimal for pepsin. -1.8

Rennin is a proteolytic enzyme found in gastric juice of infants. It helps in digestion of milk protein.

Small amount of lipases are also secreted by Gastric glands.

Various types of movements are generated by the muscularis layer of the small intestine.

This helps in thorough mixing up of the food with various secretions in intestine & thereby facilitate digestion.

released through hepato pancreatic duct.

- ① Bile
- ② Pancreatic juice
- ③ Intestinal juice

3 secretions released into small intestine.

### Pancreatic Juice

- ① Inactive enzyme → Trypsinogen, Chymotrypsinogen, procarboxypeptidase
- ② Amylase
- ③ Lipases
- ④ Nuclease.

~~Intestinal Mucosa~~

↓ gives Enterokinase

Trypsinogen (Inactive)

Trypsin (Active)

Other enzymes in pancreatic juice

Breakdown of fats into small micelles

Bile helps in emulsification of fats

Also activates lipases

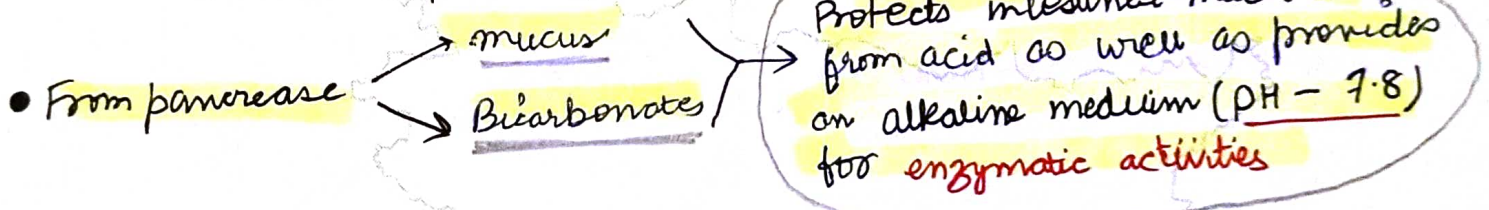
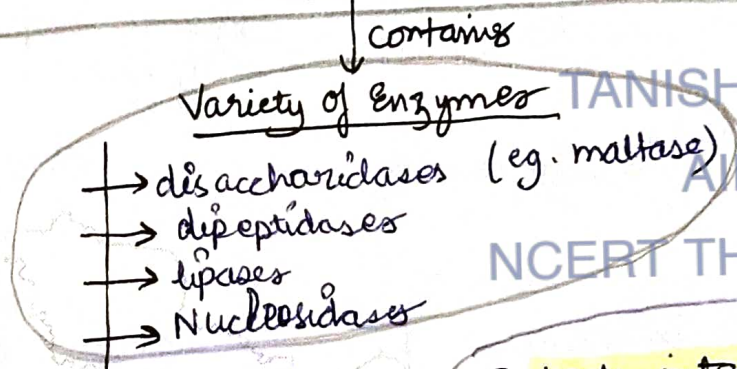
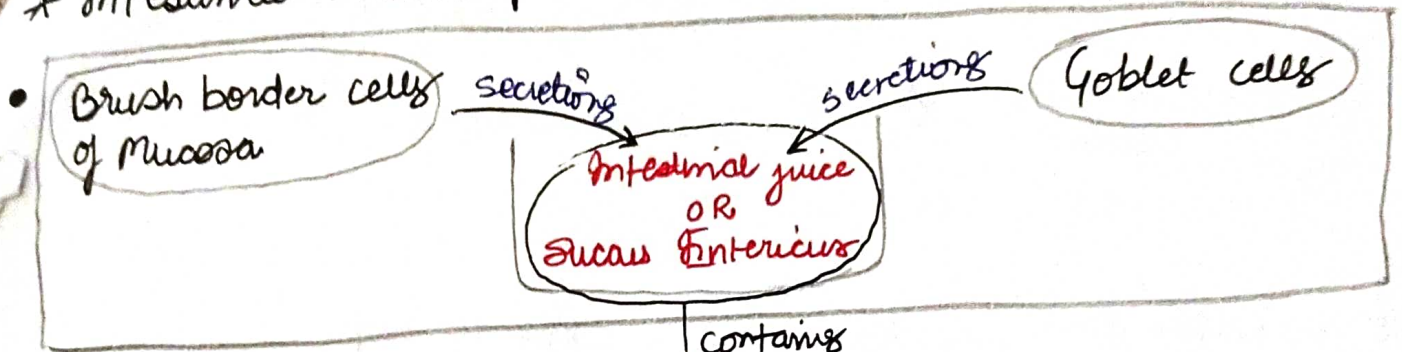
Bile ~~secretions~~ released into duodenum contains

- Bile pigments (Bilirubin/Biliverdin)
- Bile salts
- Cholesterol
- Phospholipids
- NO enzymes

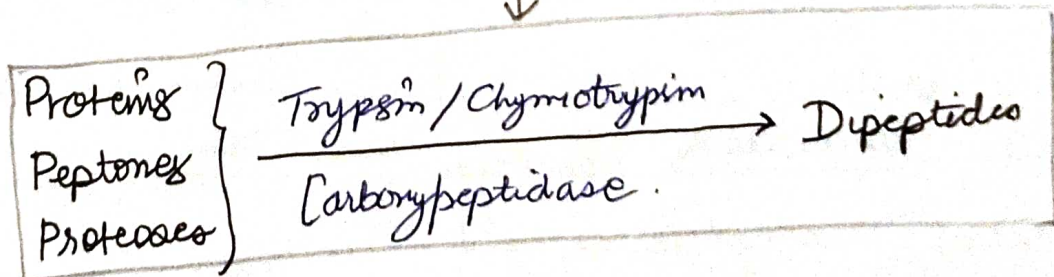
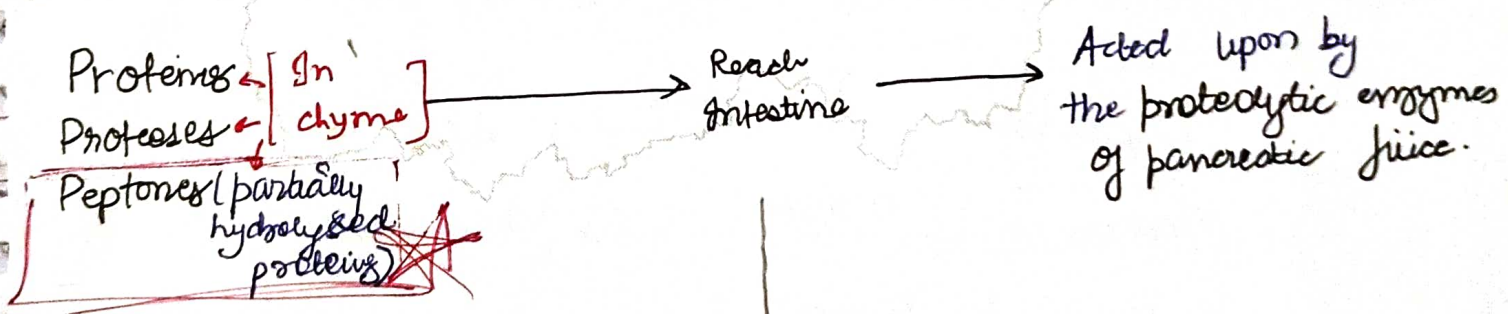




\* Intestinal mucosal epithelium has  $\rightarrow$  Goblet cells  $\xrightarrow{\text{secrete}}$  Mucus



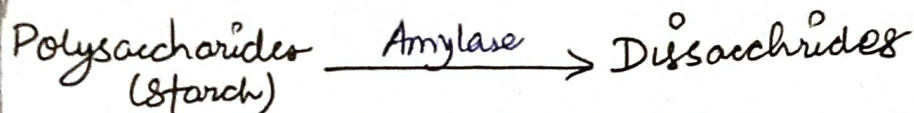
• Sub mucosal glands - Brunner's Gland.





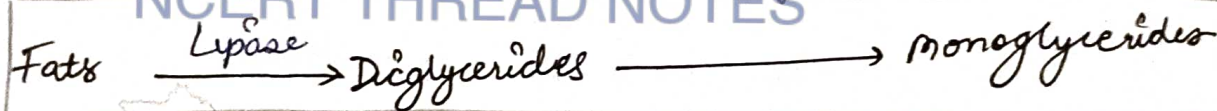


- Carbohydrates in chyme  $\rightarrow$  hydrolysed  $\rightarrow$  By pancreatic amylase



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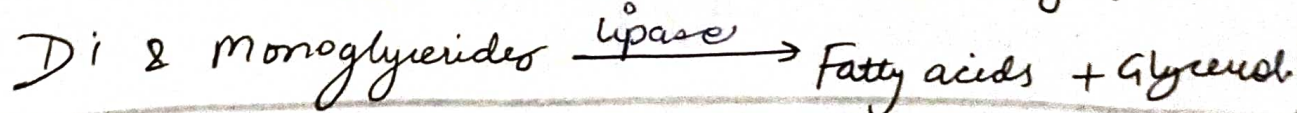
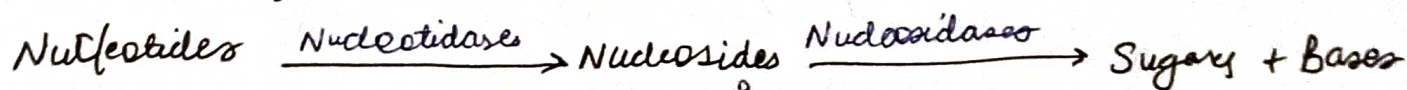
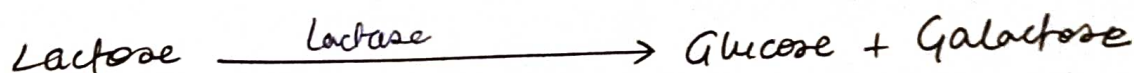
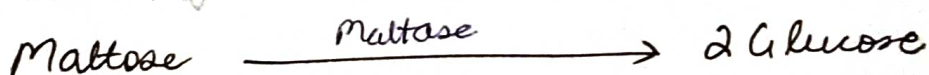
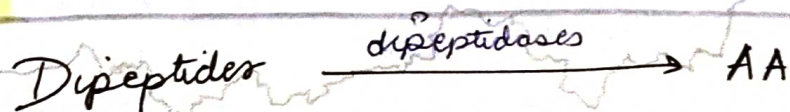
- Fats  $\rightarrow$  broken down  $\rightarrow$  By lipase  $\rightarrow$  with the help of bile



- Nucleases  $\rightarrow$  in pancreatic juice  $\rightarrow$  on nucleic acid



- The enzymes in small intestine  $\rightarrow$  act on end product of above reaction  $\rightarrow$  to form the respective simple absorbable form. These steps occur very close to the mucosal epithelium of intestine.





Breakdown of Biomacromolecules

occurs

In the duodenum region of small intestine.

simple substance absorbed

Jejunum & Ileum

Passed to the large intestine

"Undigested" & "Unabsorbed" subst.

No significant digestive activity occurs here

Functions :

(i) absorption of some ~~water~~ ~~minerals~~ ~~certain drugs~~

(ii) Secretion of mucus helps in <sup>①</sup> adhering the waste (undigested) particles together & <sup>②</sup> lubricating it for an easy passage.

"Undigested" & "unabsorbed" substance called faeces.

enters

Caecum

(through the ileo-caecal valve)

↳ prevents the back flow of faecal matter

It is temporarily stored in Rectum till defaecation.



# Activities of Gastro-intestinal tract

under "neural" & "hormonal" control.

↓ for  
proper co-ordination of different parts

① Sight, ② Smell & for the ③ presence of food in oral cavity

↓ stimulates

Secretion of Saliva

↓  
Gastric & Intestinal secretions are also  
stimulated by the neural signals.

↓  
Muscular activities of different parts  
of alimentary canal

→ Mediated by  
neural mechanism

↓ both

local

CNS

Hormonal Control - Secretion of digestive juices  
carried out by local hormones

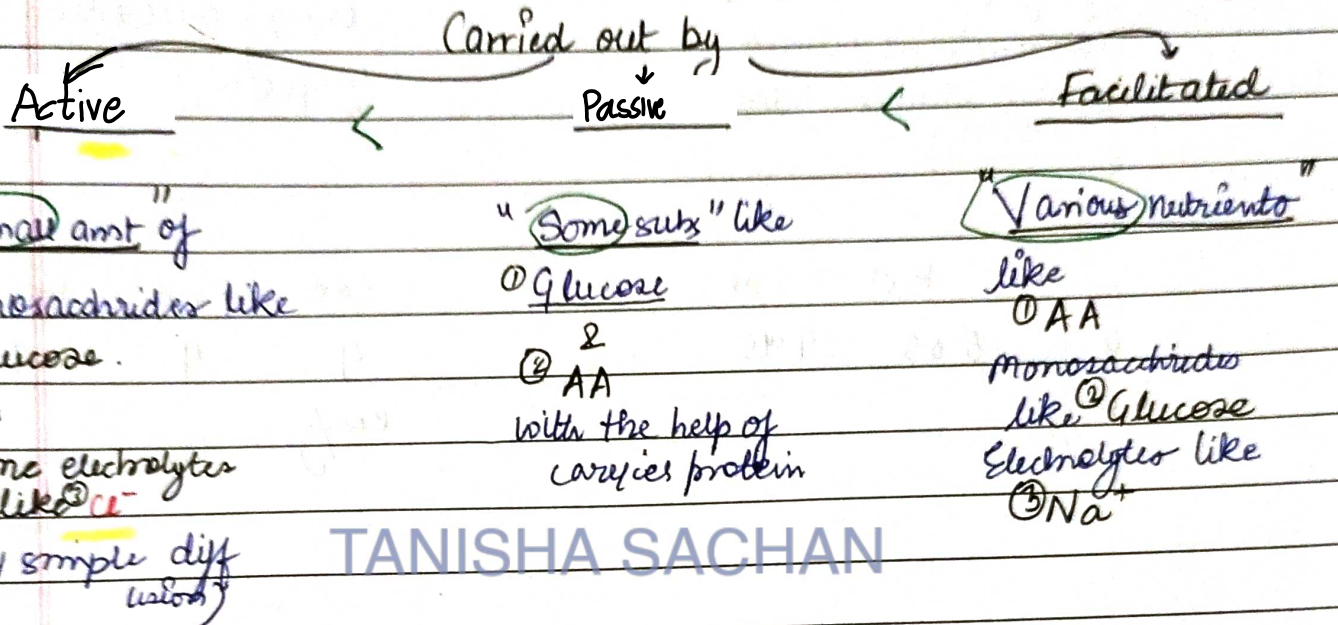
↑ produced by

Gastric & Intestinal  
Mucosa.



## Absorption of digested products :

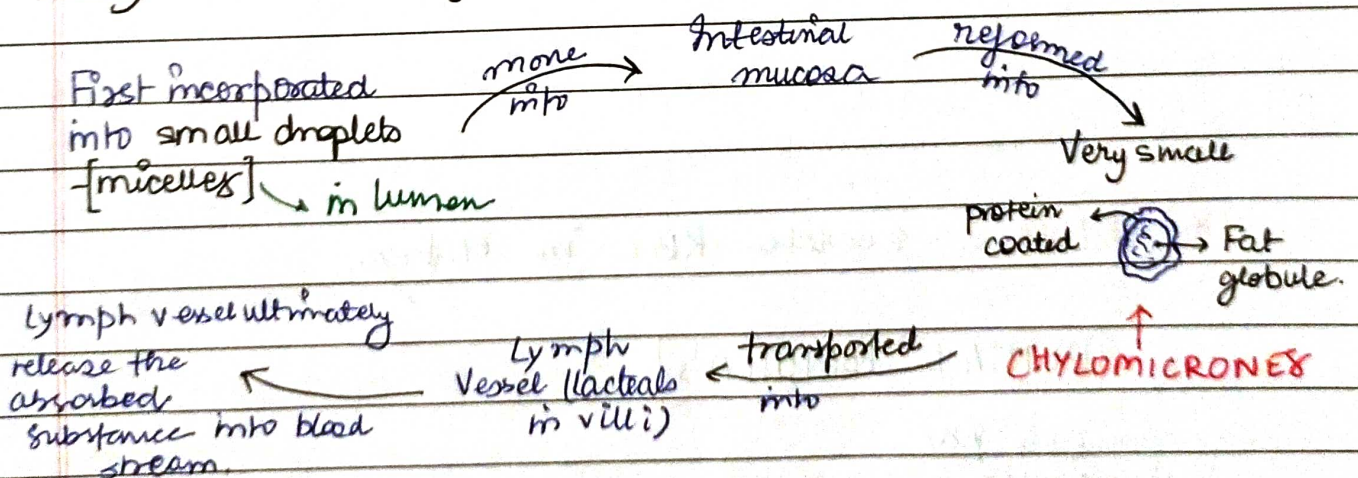
End products of digestion  $\longrightarrow$  Pass through Intestinal mucosa  $\xrightarrow{\text{into}}$  Blood or Lymph.



\* The passage of these substance  $\xrightarrow{\text{into}}$  blood, depends on conc gradient.

\* Transport of water - depends on osmotic gradient.

Fatty acids & Glycerol - Insoluble  $\rightarrow$  ~~be absorbed into blood.~~



(\*) Maximum absorption occurs in  $\rightarrow$  small intestine



\* The energy requirements of animals, the energy content of food, are expressed in terms of measure of heat energy bcz heat is the ultimate form of all energies.



### Gross calorific Value

↓  
Amt of heat liberated from complete combustion of 1g food in a bomb calorimeter. (a closed metal chamber filled with  $O_2$ )

### Physiological Values

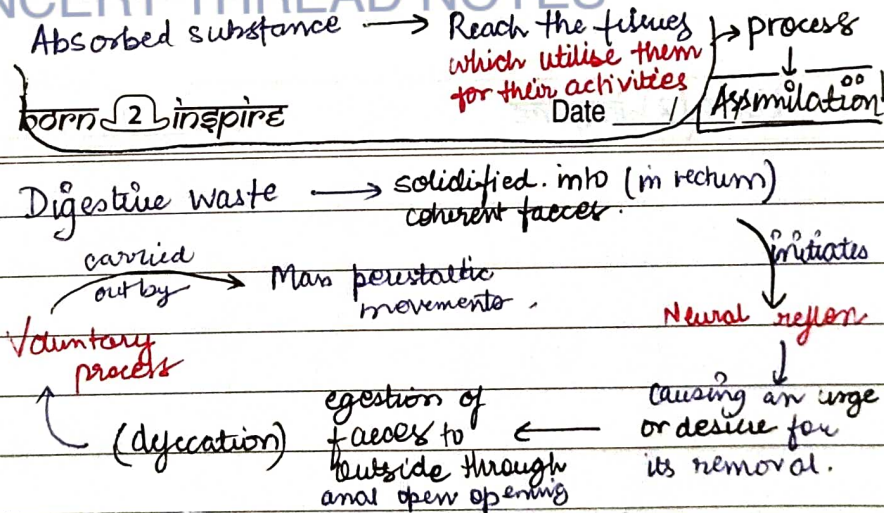
↓  
The actual amt of energy combustion of 1g food.

Carb	Prot.	Fat
4.1	5.65	9.45
Kcal/g		

Carb	Prot.	Fat.
4	4	9
Kcal/g		

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### NCERT THREAD NOTES



\* Liver - secretes RBC in embryo.

### DENTAL FORMULA'S

(25 yrs)  
1) ADULT -  $\frac{2123}{2123}$   
2) INFANT -  $\frac{2102}{2102}$   
↓  
Pse molar  
& last molar absent

2) ADOLESCENT -  $\frac{2122}{2122}$   
(18 yrs)  
↓  
Wisdom tooth absent.





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PEM → Protein Energy malnutrition.

- Dietary deficiency of  $\begin{cases} \text{Proteins} \\ \text{Total food calories} \end{cases}$
- Widespread in many "underdeveloped countries of"  $\begin{cases} \text{South Asia} \\ \text{South East Asia} \\ \text{South America} \\ \text{West Africa} \\ \text{Central Africa} \end{cases}$
- Affects large section of popul. during  $\begin{cases} \text{Drought} \\ \text{Famine} \\ \text{Political Turmoil} \end{cases}$

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- Happened in  $\begin{cases} \text{Bangladesh: during liberation of war.} \\ \text{Ethiopia: Severe drought in mid-80s.} \end{cases}$

Marasmus :

→ Simultaneous deficiency of proteins & calories.

→ Found in the infants of < 1 yr age.

→ Mother's milk replaced too early by other foods which are poor in  $\begin{cases} \text{Proteins} \\ \text{Caloric value} \end{cases}$

→ Often happens when mother has 2nd pregnancy or child birtu when the older infant is still too young.

• Impairs Growth & Replacement of tissue proteins

• Extreme emaciation of body

• Thinning of limbs

• Skin becomes  $\begin{cases} \text{dry} \\ \text{thin} \\ \text{wrinkled.} \end{cases}$

• Growth Rate ↓

• Body weight ↓

• Growth & development of Brain & mental faculties impaired.

Kwashiorkor :

→ Prod. by Protein deficiency "unaccompanied" by calories deficiency

→ Results from replacement of mother's milk by a high calorie - low protein diet in a child of > 1 yr age.

→ Wasting of muscles

→ Thinning of limbs

→ Failure of growth & Brain develop.

→ Some fat is still left under skin (unlike marasmus)

→ Extensive oedema.

→ Swelling of body parts.





## Disorders of digestive system.

Most common: Inflamm. of intestinal tract.

↓ due to

Bact. / Viral Infection.

OR.

Parasitic Infection. (In intestine)

- ① Hookworm, Pinworm.
- ② Tape worm, thread worm.
- ③ Round worm.

### Saundice

Liver affected.  
Skin & Eyes turn yellow.

↓ due to  
deposit of bile pigm.

### Vomiting

Ejection of stomach content through mouth.

This Reflex action controlled by vomit centre (in medulla)

A feeling of nausea precedes ↓

vomit

### Diarrhoea

• Abnormal freq. of bowel movement &

Increased liquidity of faecal discharge

★ It reduces the absorption of food.

### Constipation

Faeces retained within colon.

Bowel movements occur irregularly.

### Indigestion

Food is not properly digested leading to a feeling of fullness (causes)

→ maldig. enzyme secr.

→ anxiety

→ food poisoning

→ overeating

→ Spicy food.

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